Cephalic Sclerites and Chaetotaxy of a Hairy Caterpillar, *Lymantria marginata* Wlk. (Lepidoptera: Lymantriidae)

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Abstract. The head capsule sclerites and cephalic chaetotaxy of first instar larva of *Lymantria marginata* Wlk. are described. Primary setae and punctures of first instar are constant in number and position. Each half of the capsule is characterized by the presence of 21 primary setae and 10 punctures. The A3 seta of the anterodorsal group is the longest seta on the cranium. Additional secondary setae are recorded for each successive instar. Most setae were added in second and third instars. The punctures and number of setae of vertical, genal and clypeal groups remained unchanged throughout larval development.

Introduction

Dyar (1896), Forbes (1910), Gardner (1938), Hinton (1946, 1947), Bucker (1967), Goel and Kumar (1981) and Kumar and Goel (1986) have described cephalic chaetotaxy of several lepidopteran larvae of taxonomic significance. Most work deals with non-hairy caterpillars for simplicity. The first instar larva presents a generalized plan of tubercles and setae in Lepidoptera. However, hairy caterpillars have shown remarkable differences from the first instar larva into their subsequent instars. The changes for each instar need to be explored for a proper understanding of the morphological variations between species. The cephalic chaetotaxy of *Lymantria marginata* Wlk., a defoliator of mango in North India (Singh and Goel, 1986), is described. The morphological changes involved during successive instars are also elucidated.

Materials and Methods

The caterpillars from first to seventh instars in laboratory culture were killed and fixed in KAAD mixture (Peterson, 1962) and stored in 70% alcohol. The head was removed after placing the larva in heated 5% KOH for 2 minutes. The material was washed in distilled water, dehydrated and stained with hematoxylin, and mounted in Canada balsam. Exuviae from each instar were also mounted in Canada balsam and used for confirming setal patterns and punctures. Illustrations were done with the aide of a camera lucida on high power microscope (Olympus). The setal numbers groupwise on the head capsule were counted from first to seventh instars and their morphological changes at each moult were recorded. Five head capsules representing each instar were observed for setal counting. The distribution of setae is given in Table 1 for different instars on each half of the cephalic region. Hinton's (1947) terminology is followed.

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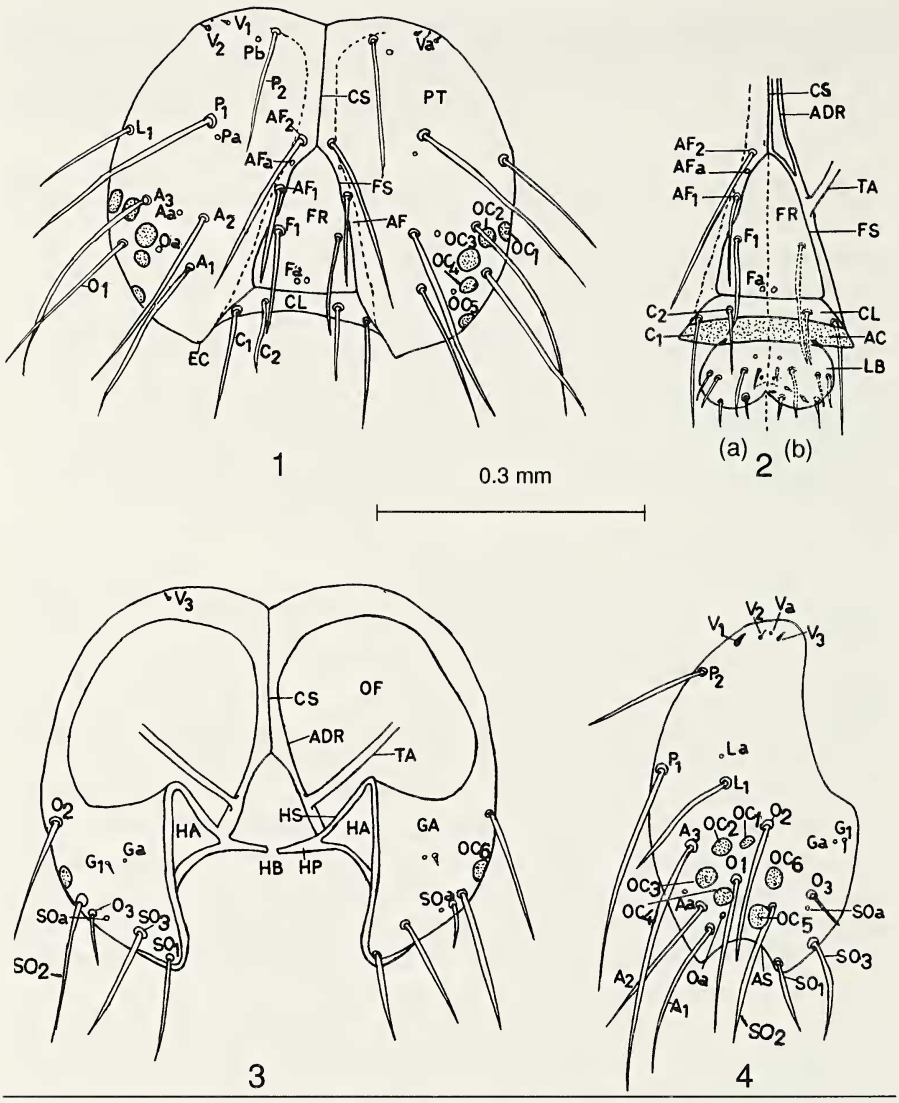
Table 1. Distribution of primary setae of first instar larva and additional secondary setae for different instars on each half of the cephalic region of *Lymantria marginata* Wlk.

Setal group	Instar stages						
	I	II	III	IV	V	VI	VII
Vertical group (V)	3	3	3	3	3	3	3
Clypeal group (C)	2	2	2	2	2	2	2
Genal group (G)	1	1	1	1	1	1	1
Posterodorsal group (P)	2	17	27	29	32	29	30
Lateral group (L)	1	2	2	3	2	3	3
Adfrontal group (AF)	2	2	7	6	7	6	6
Frontal group (F)	1	3	5	7	6	9	10
Anterodorsal group (A)	3	14	28	27	23	25	26
Ocellar group (O)	3	5	12	11	9	10	11
Subocellar group (S0)	3	5	7	9	8	9	10
Total	21	54	94	98	93	97	102

Results

The head capsule: The head capsule of *L. marginata* is heavily sclerotized, dark brown, elliptical and compressed cephalocaudally in a hypognathus orientation. The two upper region large sclerites, parietal or vertex (PT) of the epicranium are demarcated by an inverted Y-shaped coronal adfrontal sulcus (Fig.1). The coronal stem(CS) splits ventrally into two adfrontal (AF) cleavage lines. Each adfrontal sulcus terminates anteroventrally at the epicondyle (EC), a place for dorsal articulation of the mandible of that side (Fig.1). The triangular sclerite enclosed between lateral arms of frontoclypeal suture is the frons (FR). The tentorial arms (TA) arise from the lateral adfrontal sutures to internally strengthen the head capsule. The clypeus (CL) lies in front of the frons and a thin cuticular anteclypeus (AC) is attached to it for articulation of the labrum (LB). Because of the weak adfrontal cleavage line, the narrow strip between the frontoclypeus and parietals denotes the adfrontal area (AF) which appears inflected into the adfrontal sulcus (ADR) (Fig.2). The parietal of either side posteriorly forms the genal area (GA) which supports the triangular hypostomal area (HA). Both areas are separated by hypostomal sutures (HS) and extend mesially into hypostomal process (HP) to connect to a similar process of the other side forming a membranous hypostomal bridge (HB) (Fig.3). There are six ocelli (OC1-OC6) on either side of the cranium posterolateral near the antennal socket (AS) (Fig.4). The cranium posterodorsally is perforated by a large occipital foramen (OF) (Fig.3).

Cephalic chaetotaxy: The head capsule of the first instar *L. marginata* is characterized by the presence of 21 primary setae of which 17 are long



Figs. 1-4. Head capsule of first instar caterpillar of Lymantria marginata
Fig. 1. Anterior view
Fig, 2. Frontoclypeus with labrum (a) Frontal view (b) Inner view
Fig. 3. Posterior view
Fig. 4. Parietal (lateral view)

Abbreviations

Aa Anterodorsal puncture
A1-3 Anterodorsal setae
AC Anteclypeus
ADR Adfrontal sulcus
AF Adfrontal
AFa Adfrontal puncture
AF1-2 Adfrontal setae
AS Antennal socket
C1-2 Clypeal setae
CL Clypeus
CS Coronal stem
EC Epicondyle
Fa Frontal puncture
F1 Frontal seta
FR Frons
FS Frontoclypeus sulcus
Ga Genal puncture
G1 Genal seta
GA Genal area
HA Hypostomal area
HB Hypostomal bridge
HP Hypostomal process
HS Hypostomal socket
La Lateral puncture
L1 Lateral seta
LB Labrum
Oa Ocellar puncture
O1-3 Ocellar setae
OC1-6 First to six ocelli
OF Occipital foramen
Pa,b Posterodorsal punctures
P1-2 Posterodorsal setae
PT Parietal sclerite or vertex
SOa Subocellar puncture
SO1-3 Subocellar setae
TA Tentorial arm
Va Vertex puncture
V1-3 Vertex setae

and 4 minute. On each half there are 10 punctures. The clypeus bears two clypeal setae C1 and C2 without punctures. The frontal group single seta (F1) lies closer to frontal suture and puncture (Fa) closer to middorsal line passing through the coronal stem (Fig.2). The adfrontal region has two setae, AF1 and AF2, and puncture AFa along the adfrontal suture.

The setae A1, A2, A3 and puncture Aa are present in the anterodorsal group of the head capsule and lie between the adfrontal and ocellar groups. Seta A3 is the largest seta on the head capsule and lies closer to OC2 and slightly posterolaterad of A2. The setae organized by length are A3>A2>A1. The ocellar group bears two almost equal sized setae O1 and O2 and puncture Oa. The seta 01 lies within the ocellar area and seta O2 is posteroventrad to O1, while O3 is ventrad of OC6. The puncture Oa is closer and anterior to OC4 (Fig.4). The seta SO1 is close to antennal socket, SO2 is between OC5 and OC6, and SO3 is posterior to SO1 (all subocellar group). Relative lengths are SO2>SO3>SO1. The puncture SOa is close to O3 anteriorly. The genal group possesses a small minute seta G1 and a puncture Ga, both posteroventrad to OC6.

The lateral group has a single seta L1 and puncture La. The seta L1 is anterolaterad to Pl, and puncture La is posterodorsad to L1. The two setae (P1 and P2) and two punctures (Pa and Pb) are part of the posterodorsal group. The seta P1 is the second largest on the head capsule and lies posterolaterad to AF2, and P2 is posterodorsad to P1. The puncture Pa lies ventrad to P1, whereas Pb is anteroventrad to P2. The vertical group is characterized by the presence of three minute setae Vl, V2, V3 and puncture Va. There is a small gap between the three setae and puncture Va lies equidistant between V2 and V3.

Distribution of secondary setae in instars I-VII : Besides the primary setae, numerous additional setae are observed on each half of the head capsule from the second through final instars, giving a tufted look to the caterpillar. However, the position of primary setae and punctures remains unchanged; primary setae have more prominent setal sockets compared with the additional setae. There are no additional punctures observed on the head capsule of any larval instar. An asymmetrical condition has been observed for secondary setae. Many additional setae occur in second and third instar larvae whereas the number of additional setae during the remaining instars increase slightly from third instar (Table 1).

The first instar larva has 21 primary setae but due to the regular increases of secondary setae at each instar, the seventh instar has 102 setae. The vertical (V), clypeal (C) and genal (G) are the only groups that do not deviate in number from first to last instar. It is notable that wherever there are increases in the AF group during the third and fifth instars and decreases in the fourth, sixth and seventh instars, than a corresponding decrease in L group setae occurs during the third and fifth instars and vice-versa in the fourth, sixth and seventh instars. The posterior region of the frons, however, has no additional setae. The

maximum setal numbers were added to the posterodorsal (P) and anterodorsal (A) groups, i.e. 56% of the total number of setae (559) from first to the seventh instar.

Discussion

The sclerites are like those of most ditrysian Lepidoptera. Snodgrass (1935) described the triangular frontal part as the clypeus while Hinton (1947) called it the frontoclypeal apotome. Walker (1931) applied the names anteclypeus and postclypeus. In the present study the frons, clypeus and anteclypeus, by their clear demarcations are considered separate. DuPorte (1946) described the epicranial suture as a line of weakness which normally splits open during ecdysis (Hinton, 1947). In *L. marginata* and most Lepidoptera, especially butterflies, the coronal stem splits only at the time of pupation and not at each stadial ecdysis.

Number of setae can be used to identify the instar of *L. marginata.* The size of the frontoclypeus relative to the head capsule was used to identify instars by Singh (1956) and Mathur and Singh (1963), but the proportion of the frons and coronal stem is almost equal in first and second instar of *L. marginata.* The adfrontal area is less distinct in *L. marginata,* as described by Crampton (1921) than in some other Lepidoptera.

The number and position of setae and punctures on head capsules of *L. marginata* appears typical of Lepidoptera as described by Heinrich (1916), Hinton (1946), Mukerji and Singh (1951), Mathur and Singh (1963), Bucker (1967) and Goel and Kumar (1981). A few other studies of lymantriids are available. The same position of seta F1 and puncture Fa was observed by Forbes (1910) in a lymantriid, *Hemerocampa leucostigma.* Seta A3 is the longest seta on the cranium in *L. marginata* whereas Hinton (1946) described P1 as generally the longest seta of the cranium. Bucker (1967) reported A2 as the longest seta in his study of four lymantriid species.

The ocellar and subocellar groups of *L. marginata* are like those reported by Mathur and Singh (1963) in pyralid larvae and by Bucker (1967) in lymantriids. The genal group of *L. marginata* has a single minute seta and puncture. The same condition agrees with Heinrich (1916), Ripley (1923), and Downey and Allyn (1979). Hinton (1946) has described two setae G1 and G2 and one puncture (Ga), instead of one seta, in Lepidoptera. One seta (G1) and two punctures (Ga and Gb) have been reported by Goel and Kumar (1981) in a arctiid, *Diacrisia obliqua* (Wlk.).

Hinton (1946) differentiated the Lymantriidae as a specialized family of the ditrysian group by the presence of secondary setae or punctures following the first or succeeding moults. Being prominent and smooth, the primary setae hardly lose their identity from the surrounding secondary setae even after first instar. The punctures and setae of the vertical, genal and clypeal groups remained unchanged throughout the larval period of *L. marginata* in position and number. However, no setae were detected in the upper part of epicranium and frons in this study.

Forbes (1910) described the upper portion of the epicrania and frons as having no additional setae in the lymantriid *Euproctis chrysorrhoea*. The part of the vertex and gena which retracts into the prothorax possessed three minute setae on the vertex and on the caudal part of each side of the gena. According to Hinton (1946), the minute setae were positioned in the overlapping parts and functioned as proprioceptors as those on the thorax and abdomen. Likewise, the presence of the greatest number of secondary setae are in the posterodorsal and anterodorsal groups in *L. marginata*. The long setae, which undoubtedly function for tactile purposes, are rather evenly distributed over the anterior and exposed parts of the head.

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